

### Office Action Summary

**Application No.**

10/811,230

**Applicant(s)**

GANGULI ET AL

**Examiner**

KELLY STOUFFER

**Art Unit**

1792

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 14 January 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) See Continuation Sheet is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-2,4-7,9-14,16-17,19-20,22-25,27-28,30-33,35-38,40-42,44-46,48-51,53-67 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☒ Interview Summary (PTO-413)  
Paper No(s)/Mail Date attache d
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

Continuation of Disposition of Claims: Claims pending in the application are 1,2,4-7,9-14,16,17,19,20,22-25,27,28,30-33,35-38,40-42,44-46,48-51 and 53-67.

### **DETAILED ACTION**

Though an RCE was filed by the applicant on 14 January 2008, the previous office action dated 16 October 2007 was a non-final. Hence, the following action is a final rejection, as discussed below and in an examiner-initiated telephone interview, the summary of which is attached.

The cancellation of claims 3, 8, 15, 21, 26, 29, 34, 39, 43, 47 and 52 is acknowledged.

### ***Response to Arguments***

Applicant's arguments filed 14 January 2008 have been fully considered but they are not persuasive. The applicants' arguments were drawn to the previously cited prior art not teaching the elements of the independent claims. The elements of the independent claims are taught by the prior art as discussed below, and the rejections of the previous office action are maintained. New grounds of rejection are presented below for newly added claims 56-67.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 2, 4-7, 9-14, 16-17, 19-20, 22-25, 27-28, 30-33, 35-38, 40-42, 44-46, 48-51, and 53-67 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aaltonen et al. (US 2003/0165615) in view of Kawano et al. (US 6605735).

As to claim 1, Aaltonen et al. discloses a method of forming a ruthenium layer comprising a ruthenium layer deposited by pulsing a ruthenium precursor into a chamber and exposing it to the barrier layer and therefore chemisorbing it, and

exposing the ruthenium layer to a reducing gas and reacting it to form the ruthenium layer, with purge gas pulses in between the pulses of reactant gases (paragraph 0021). Aaltonen et al. does not disclose the ruthenium precursors as required by claim 1. Kawano et al. teaches using the ruthenium compounds claimed as shown in column 3 line 39- column 4 line 12 in CVD because the compounds give the benefit of low temperature deposition and ease of supplying a precursor in gas form (column 3 lines 17-23) as the precursor cures the deficiencies of other precursors as discussed in columns 1 and 2 et seq. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Aaltonen et al. to include the precursors of Kawano et al. in order to use a precursor that gives the benefit of low temperature deposition and ease of supply. It also would have been obvious at the time of the invention to use CVD processes in an ALD process because "a person of ordinary skill has good reason to pursue the known options with his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense." Aaltonen et al. teaches that one of ordinary skill in the art would use ALD over CVD because of improved step coverage, uniformity, and thickness control (paragraph 0007). One of ordinary skill in the art would certainly find it within their technical grasp to use a CVD precursor in an ALD process with a reasonable expectation of success, given the advantages of using ALD in Aaltonen et al. and the precursors in Kawano et al. (See *KSR International Co. v. Teleflex Inc.*, 550 U.S.--, 82 USPQ2d 1385 (2007)).

Aaltonen et al. and Kawano et al. do not explicitly teach using the combination of ammonia and atomic hydrogen as a reducing agent. The applicant, however, admits that reducing agents such as ammonia, atomic hydrogen, etc. and combinations thereof are traditional reducing agents, indicating that their use is well-known and documented in the prior art (paragraph 0068 of the instant specification). Therefore, it would have been obvious to one of ordinary skill in the art to use a traditionally accepted reducing agent with the ruthenium compound, given the reasonable expectation of success provided by using a traditionally proven compound. This limitation would have been obvious because the substitution of one known element for another would have yielded predictable results to one of ordinary skill in the art at the time of the invention. (See *KSR International Co. v. Teleflex Inc.*, 550 U.S.--, 82 USPQ2d 1385 (2007).

Regarding claims 2 and 4, Kawano et al. teaches the claimed ligands in column 3 line 39- column 4 line 12.

Regarding claim 5, Kawano et al. discloses the reducing gas to include a nitrogen carrier gas in the examples.

Regarding claim 6, Aaltonen et al. discloses the ruthenium layer being formed at 300-360 °C (paragraph 0059).

Regarding claim 7, Aaltonen et al. discloses the ruthenium layer to be able to have a thickness of about 20 Å (paragraph 0071).

As to claim 9, Aaltonen et al. discloses depositing the ruthenium over a barrier layer including those claimed in paragraphs 0063, 0066-0067, for example.

As to claim 10, Aaltonen et al. discloses a low-k material of those claimed on the substrate in paragraphs 0063-0064, for example.

Aaltonen et al. in view of Kawano et al. includes all of the provisions of claim 11, as the ruthenium precursor taught by Kawano et al. includes bis(2,4-dimethylpentadienyl)ruthenium (column 3 line 39- column 4 line 12).

Aaltonen et al. in view of Kawano et al. disclose claims 12-14, 16-17, 19-20, 22-25, 27-28, 30-33, 35-38, 40-42, 44-46, 48-51, and 53-67 as described above.

Regarding claim 55, Aaltonen et al. in view of Kawano et al. includes all the requirements of claim 55, and additionally Aaltonen et al. discloses the ruthenium layer as a seed layer for copper deposition and being deposited overtop a barrier layer in paragraph 0006.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to KELLY STOUFFER whose telephone number is (571)272-2668. The examiner can normally be reached on Monday - Thursday 7:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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